

OBSERVATIONS UPON THE SURGICAL ANATOMY
OF THE KIDNEYS, WITH SPECIAL REFER-
ENCE TO THE TWELFTH RIB, THE PLEURA
AND THE DIAPHRAGM, AND THE
QUESTION OF EXPLORATORY IN-
CISIONS INTO THE PELVIS OF
THE KIDNEY.¹

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IN the summer of 1882 I had, through the kindness of Professor Braune, of Leipzig, the opportunity of investigating the lumbar region about the kidneys, and I did that from two points of view: First, I wanted to ascertain the lower boundary of the pleura and its relations to the last rib and the diaphragm, and second, I intended to find out the most easy and favorable way by which we might get at the pelvis of the kidneys. I am sorry to say, that neither time nor material were at my disposal to such an extent, that to either of the above questions I can offer an exhaustive elaboration, still I hope that my investigations may offer some of the interest they have given to me, and that so much more, since we have to deal with an anatomical region, which lately, more than ever, has attracted the attention and called forth the skill of the surgical world.

¹This paper in its essential parts was read before the New York Surgical Society more than two years ago. I then had the intention to follow up this subject and to give it a more complete elaboration before publishing it. Want of time has so far prevented me from doing so, and I doubt whether, under the pressure of practical work in America, I shall ever find the opportunity. Perhaps others, who are working under more favorable conditions, might be induced to bring some of the questions treated in this paper to a more complete and satisfactory conclusion.

You are aware that the late Professor Dumreicher, of Vienna, had the misfortune to open the pleural cavity during an attempt to remove a pyonephrotic calculous kidney. At the autopsy it was found that the last rib was rudimentary, that the pleura projected beyond its lateral end and a good deal below the lower edge of the eleventh rib, which had been taken for the twelfth, and that in elongating the incision toward the point last mentioned, the unlucky accident was unavoidable. Still this accident had one good result, in that it gave birth to the investigations made by Dr. Holl, of Vienna, about the frequency of rudimentary development of the last rib, and about the relation of pleura and diaphragm in such cases. Dr. Holl found that in quite a considerable percentage the last rib is abnormally short, so that it does not reach as far as the border of the *musculus sacrolumbalis*, or so rudimentary that in some cases it is more similar to an articulatory process *transversus*; that, however, the insertion of pleura and diaphragm are not different from the normal anatomical relations on these same cases, the lower edge of the pleura going from the lower boundary of the last dorsal vertebra in almost horizontal direction toward the lower edge of the eleventh rib in the way explained in this sketch. He therefore very justly recommended, in order to avoid danger resulting from such anatomical relations, always to count the ribs before intended nephrectomy. His investigations do not, however, give us the certainty, whether normal development of the last rib, at all events, gives us a guaranty that lesions of the pleura in lumbar incisions are out of question.

A glance at this very rough sketch, Fig. 1, made in the dissecting room, will convince you that exceptionally even normal development of the last rib demands extreme caution. You see here the twelfth rib developed rather well, the diaphragm (*bb*), proceeding from the upper edge of the transverse process of the first lumbar vertebra horizontally, and reaching the rib at a point several centimetres beyond the lateral border of the *quadratus lumborum* (*d*). About one-third of a centimetre above the lower edge of the diaphragm the pleura commences (*ff*), and you see to what an extent it projects beyond the lower edge of the twelfth rib. It is covered by a thin fascia,

which has been removed except in this area, where it is thickened after the manner of a ligament (*g*), which runs from the transverse process of the first lumbar vertebra, in oblique upward direction, toward the border of the last rib. An incision along the lateral edge of the quadratus lumborum, which

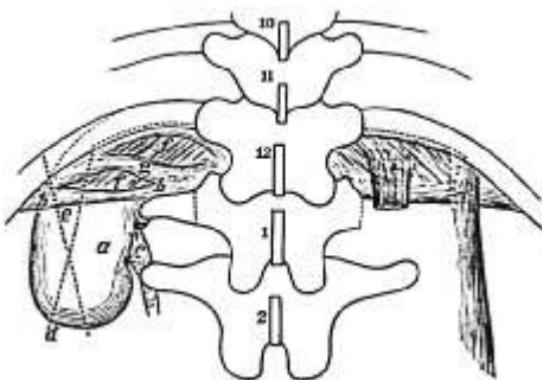


FIG. 1. EXCEPTIONAL RELATIONS OF TWELFTH RIB, PLEURA AND DIAPHRAGM (*from nature*).

a, kidney; *bb*, lower edge of diaphragm; *c*, pelvis of kidney; *d*, lower edge of quadratus lumborum; *e*, outer edge of sacrolumbalis; *ff*, pleura; *g*, thickened portion of fascia covering pleura; *h*, slip of quadratus lumborum inserted into fascia covering pleura.

is indicated by the dotted line (*d*), would have been very dangerous in this case; and the incision in the line of the sacrolumbalis (*e*) would not yet have been entirely out of danger, though much less dangerous than the former.

In the right side of the same body I found the following interesting abnormality: After the transverse process of the first lower vertebra, which in this case had movable articulation with the vertebra, had been removed, and the quadratus lumborum separated from its upper attachment to the twelfth rib, it was found that a small bundle of its fibres made its insertion at the pleura, or rather at the thin fascia which covers the pleura and is in somewhat intimate connection with it, Fig. 1 (*h*). In other respects the anatomical relations were identical to those on the other side.

Again, this second sketch, Fig. 2, equally rough with the other, is still apt to prove that not in all instances of rudimentary development of the last rib, is the pleura likely to come within the scope of danger.

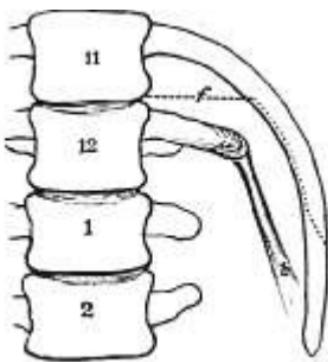


FIG. 2. RELATION OF PLEURA TO RUDIMENTARY TWELFTH RIB
(*from nature*).

s, ligamentous prolongation of rudimentary twelfth rib; *f*, dotted line indicating lower edge of pleura.

You see here the lower boundary of the pleura (*f*) passing from the lower edge of the eleventh dorsal vertebra, at a good distance above the last rib, horizontally toward the eleventh rib, so that the twelfth, which is only four centimetres long, might almost entirely protect the pleura against being incised from below. The quadratus lumborum in this case had its main insertion on the twelfth rib; a portion of its fibre, however, proceeded to the lower edge of the eleventh, and its lateral border allows a minute angle of the pleura to project laterally.

The diaphragm showed an enormous gap, and the muscle-fibres were absent from the arcus Halleri internus above the upper part of the psoas as far as the extreme one-fourth of the eleventh rib. Between these two points the fibres of the diaphragm communicated in a high arch, bounding an area within which the fatty tissue about the kidney was in direct con-

tact with the pleura. In a case like this the progress of an inflammatory process from the perinephritic tissue to the pleura, and vice versa, might find a very favorable anatomical predisposition.

Before I proceed to the second part of my paper, let us reconsider the normal position of the kidneys. Allow me to show these two sketches, Figs. 3 and 4, representing horizontal sections through the body of a well-developed male, whose blood-vessels had been injected. The upper section is made through the first lumbar vertebra immediately below its junction with the last dorsal. Imagine yourself looking upon the surface of the lower section. Let us bear in mind that the upper end of the kidneys are nearer to the spinal column than the lower ones; that the hilus is directed rather forward (according to Luschka, the elongated axes through the hilus cut each other at an angle of about 60° before the middle of the first lower vertebra), and that, as a rule, the left kidney reaches somewhat higher than the right one. According to Luschka the upper edges of the kidneys correspond about to the middle of the eleventh dorsal vertebra, while Braune and others assume the upper boundary of the twelfth to be the average height. The latter author emphasizes that the position of the kidneys under the liver and spleen respectively renders it probable that enlargements or dislocations of said organs must influence the position of the kidneys, and he proves that from an analysis of some of the plates of Pirogoff's *Atlas of Topographical Anatomy*, where enlarged liver and spleen have dislocated the kidneys so far that the hilus, which is generally met with at the height of the first lumbar vertebra, corresponds about to the fourth; and from another plate, illustrating a pleuritic exudation in the right pleural cavity, where no part of the kidney is met with at the height of the middle of the twelfth dorsal vertebra. You remember also that, as a rule, the location of the hilus of the kidneys is such that it does not correspond to the middle of the anterior edge, but more to the front part of the posterior surface, the way it is presented in this sketch.

In order to ascertain whether respiratory movements might modify the position of the kidneys, the following experiments were made:

I. Cadaver of a well-nourished male of about 35 years of age, lying in prone position. Both kidneys are laid bare by long lumbar incisions reaching upon the posterior surface of what seemed to be the last rib. Later examination showed that in fact it was the eleventh, while the twelfth was so short that it did not reach the lateral border of the quadratus lumborum. An incision along the latter muscle would have, in this case, surely opened the pleural cavity, the border of which is even below the apex of the twelfth rib. From here it passes in an oblique downward direction toward the eleventh.

The lungs are insufflated and it is clearly observed that both kidneys move downward, the right one about two, the left about one and a quarter centimetres. At the same time they are slightly pushed backward. During and after expiration the kidneys slowly return to their former position. The cadaver is then raised and suspended so that it stands upright on its feet. In this procedure both kidneys sink downward very distinctly, the right one almost four and the left more than two centimetres, at the same time they approach toward the anterior abdominal wall. Repeated insufflation causes, as the most striking change, a backward dislocation. The posterior convex edge is approaching about one centimetre. The downward dislocation is very insignificant.

The cadaver is already in an early stage of decomposition.

II. The cadaver of a strong, vigorous man of about 25 to 30 years of age; well preserved. Lower extremities still in a state of rigor mortis.

Lumbar incision along the border of the sacro-lumbalis. Twelfth rib well developed; the lateral end standing about as high as the transverse process of the third lumbar vertebra in the posterior axillary line. Belly posture. Insufflation: The kidneys descend about one and half centimetres, at the same time they are slightly dislocated backward and in lateral direction. During expiration they slowly return almost to their former position. The trachea is then closed hermetically and the cadaver brought into upright posture. Both kidneys sink about two and a half centimetres downward and to the same extent forward. Then the trachea is opened; the kidneys sink still more, approach to the posterior surface of the body and turn around their longitudinal axis so that the hilus becomes directed more forward. Insufflation causes both kidneys to descend, the right about two, the left about one and a half centimetres. The lower sinus of the pleura, which now reaches as far as the lower boundary of the processus transversus of the first lumbar vertebra, is tightly filled with insufflated

lung and pushed somewhat downward together with the diaphragm. This relation becoming evident after removal of the upper part at the quadratus lumborum. Possibly during life the lung does not come down as far as this. Henle and others at least think so. Assuming, however, such a far-going inspiration possible, than in our case lumbar incision along the border of the quadratus lumborum would have been dangerous only at the height of such an inspiration, while during expiration the pleura and diaphragm come less in question. The border of the vertebral portion of the diaphragm is, on the left side, distinctly higher than on the right. On both sides it corresponds about to the lower border of the transverse process of the first lumbar vertebra; on the right side slightly deeper.

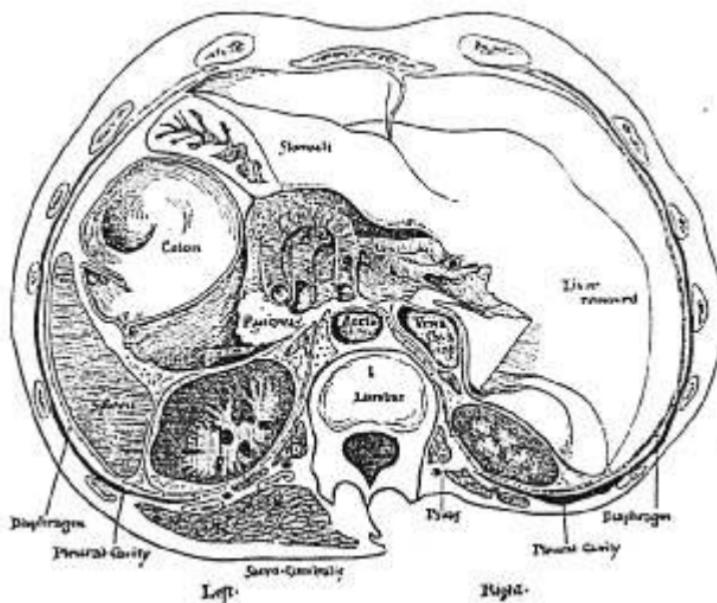


FIG. 3. HORIZONTAL SECTION OF BODY THROUGH FIRST LUMBAR VERTEBRA (*surface of lower section*).

It remains to be added that in the above experiments rather forced inspiration was used, and I am far from drawing any absolute conclusions therefrom. It seems, however, probable that strong respiratory movements may, from the organs lying

above the kidneys, cause slight movements of the latter in the living person, and that especially upright posture might give to these organs a decidedly lower position than that which we find in the cadaver, the latter, as a rule, representing the state of extreme expiration. Thus this transverse section showed the kidneys in their highest anatomical location. That considered, now let us further analyze it.¹ See Fig. 3.

In this instance the left kidney is considerably higher than the right one, of which the uppermost part only has been cut off. Immediately around both kidneys we find the adipose capsules well developed along the anterior and posterior edges, while on the right side it almost does not exist at all along the anterior surface, which is tightly covered by peritoneum, and almost to its whole extent is in contact with the posterior and lower surface of the liver. From the psoas and quadratus lumborum it is separated by the diaphragm, which you see indicated by the dotted line, and behind the diaphragm you see the pleural cavity. You see distinctly how it reaches beyond the lower edge of the twelfth rib, which here, on account of the oblique downward direction of the rib, is at the same time the internal. Corresponding to the lateral edge of the kidney the space is about two and a half centimetres deep, and further on the highest point of lateral convexity of the thoracic wall about six centimetres. That is about the ninth intercostal space. On the left side the pleura commences more laterally and does not reach beyond the middle of the twelfth rib, while the depth of its cavity could not be ascertained in consequence of old pleuritic adhesions. At this point, which indicates the lateral end of the ligamentum coronarium hepatitis, the peritoneum leaves the lower, or rather anterior surface of the diaphragm and gradually rises upon the anterior surface of the kidney. On the left side it ceases suddenly at the posterior edge of the spleen, the latter organ leaning with the posterior half of its inner surface, which here is not covered by peritoneum, toward the left kidney.

I now beg to call your attention to this transverse section, (Fig.

¹ I have since observed respiratory movement of kidneys in the living subject, (cf. lower down.)

4,) which is carried almost two vertebræ below the first, just between the second and third lumbar vertebræ. The surface of the upper segment as seen from below is shown in the drawing. You see here, also, what was less evident in the former plate, that the left kidney is somewhat more directed in front, and corresponding to that its anterior edge comes more forward than that of the right one. The last rib has ended about one centimetre above this level, corresponding exactly to the greatest convexity of the posterior edges of the kidneys. You see the comparatively long distance from the border of the quadratus lumborum, which at this level, on the right side, almost coincides with

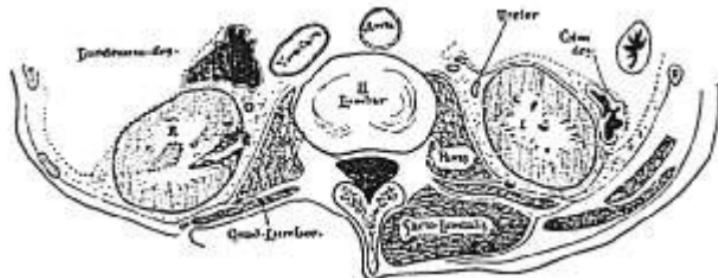


FIG. 4. HORIZONTAL SECTION OF BODY BETWEEN SECOND AND THIRD LUMBAR VERTEBRAE (*surface of upper section*).

R, right kidney; *L*, left kidney.

that of the sacrolumbalis) to the extreme point of the peritoneum parietale. You see, also, that on the left this distance is at least one centimetre smaller than on the right. A still greater difference exists between the distance from the border of the quadratus to the ureter and the pelvis; only that of the right kidney falls within the niveau of this section, and that immediately near its lowest point. A thin part of renal tissue had to be taken away in order to expose the pelvis within the hilus. From the border of the quadratus lumborum to the ureter we measure four centimetres on the right to six on the left side; and though here the pelvis, which shall be met one and a half centimetres above, might be located slightly more laterally, still that cannot be so much as to account for this great difference.

Under all circumstances it is evident from these plates, that if we intend to proceed toward the pelvis of the kidney for surgical purposes, we have to advance along the posterior surface of the organ in all those cases where the anatomical condition of parts approaches nearer the normal. We will not have to contend either with the peritoneum or the viscera lying in front of the kidneys, or last, not least, with the vessels of the kidneys which, as a rule, are situated in front, and slightly above the pelvis.



FIG. 5. OPERATION FOR EXPOSING PELVIS OF KIDNEY.

Outline to show Field of Operation.

pression that heretofore the most favorable plan for proceeding toward the pelvis and exposing it clearly to the touch and sight has not been followed. These illustrations, Figs. 5, 6, 7 and 8, represent different stages of the operation in the way I performed it on the cadaver. The position is the prone one, with slight inclination toward the side of the operation. An incision is carried along the border of the sacrolumbalis. The twelfth rib must be ascertained by counting, and its length by the touch. The border of the quadratus lumborum must be exposed. We do

In reality the number of cases is probably very small in which incisions into the pelvis for the purpose of removing stone is feasible, and it is of considerable value to find a method by which probatory incisions into the pelvis can be done with as much ease and safety as possible. I am under the im-

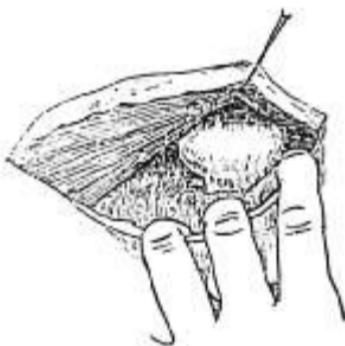


FIG. 6. PROTRUSION OF LOWER END OF KIDNEY INTO OPERATION-WOUND.
(Fat Subject).

that very cautiously near its insertion on the eleventh rib. You must remember, the higher up you go and the deeper the cut, that the pleura sometimes, even under otherwise normal conditions, reaches beyond the lateral border of the quadratus lumborum, and I would advise under no circumstances to proceed in the deeper parts beyond that line which is given by the appearance of the last intercostal nerve. This coincides usually with the lower edge of the diaphragm, provided there be no gap in the same as hinted at before. As soon as that thin fascia is dissected which surrounds the adipose capsule of the kidney, the latter protrudes into the wound, a condition of things that you see illustrated in this drawing, Fig. 6, taken after nature. Of course only the lower third of the kidney makes itself visible. It might be necessary, in fat persons, to

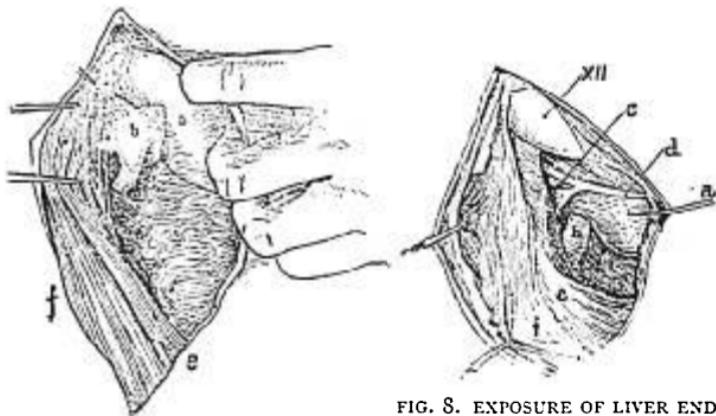


FIG. 7. SAME AS NO. 6.

Plevis and Ureter exposed by further removal of Perinephritic Fat.
 a, kidney; b, pelvis of kidney; e/f, quadratus lumborum.

FIG. 8. EXPOSURE OF LIVER END OF KIDNEY AND ADJACENT STRUCTURES IN AN EMAILED SUBJECT.

a, kidney; b, ureter; c, diaphragm; d, last intercostal nerve; e, quadratus lumborum drawn aside; f, sacro-lumbalis.

remove some of the adipose tissue on the posterior side; then the organ must be dislocated in lateral direction, the fat has to be pulled away from the posterior aspect of the pelvis, and the latter and the ureter then can be easily exposed to the extent you see it represented in this sketch, Fig. 7.

In a body like this, Fig. 8 which was emaciated to the utmost degree, and in which not the slightest particle of fat existed any more, the operation was a perfectly easy one. In stout and fat individuals a great deal of difficulty might occur owing to the depth at which the operation has to be performed. The amount of fat impedes clear view and perfect isolation of the pelvis of the kidney, and perhaps haemorrhage might become troublesome.

I will not forget to mention that in several instances I encountered a rather thick venous branch emerging from below, behind the lateral border of the pelvis and of the ureter and entering into a thick branch of the kidney vein, which abnormally took its origin from the renal substance in a level behind the pelvis. The branch coming from below, which I have found on both sides, was perhaps a spermatic vein. The cadavers were not so far at my disposal to decide this question. Probably it would be necessary in such a case to secure that vessel by double ligature.

Since the above was read I have had several times the opportunity to observe, in living persons, on whom colotomy had been performed, that in fact the position of the left kidney is influenced by respiration in the above sense, and that in the horizontal posture its descent during inspiration is quite marked, while in the upright posture it sinks downward and presents hardly any change of its position during respiration. I have also had the opportunity to practice a probatory incision into the pelvis of the left kidney, and in following the rules which I laid down according to my investigations on the cadaver, I was struck with the comparative ease and accuracy with which that operation can then be performed. The patient was an inmate of the German Hospital, aged about 45 years, who for years already had suffered from urinary disorder. In short I deemed it advisable to ascertain whether a pyelitis, which undoubtedly existed, was complicated by the presence of stone. Though the man had scoliosis, and the space between the last rib and the crest of the ilium was so narrow that two assistants had to exert force on the upper and lower end of the trunk in order to somewhat straighten the vertebral column during the operation, the access to the pelvis of the kidney

was comparatively easy. I was perfectly able to see and feel to make probatory puncture and incision into the pelvis and explore it with my finger; to insert a soft bougie and pass it down into the bladder. During inspiration the kidney descended about two centimetres. In order to dislocate its lower end laterally I should recommend to insert an armed sponge-holder on its lower end and to exert by means of that a slight pressure against the renal tissue. Any metal instrument inserted on the border or into the substance of the kidney, is apt to cause rupture of the same.

The patient just mentioned has since died—about fourteen days after the operation—under the symptoms of uræmia. He was much run down at the time of the operation, and was certainly no favorable subject for an operation. His wound had done well all the time, and never did he present any considerable rise of temperature. Nay, the direct discharge of pus from the pelvis of the kidney seemed to benefit him, inasmuch as the pain diminished and his urine became distinctly clearer. The autopsy showed that both kidneys were in an advanced stage of pyelonephritis, but only on the left one, about which great pain was located, a number of very small abscesses were present.